International Journal of Applied and Natural Sciences (IJANS)
ISSN(P): 2319-4014; ISSN(E): 2319-4022
Vol. 3, Issue 3, May 2014, 1-4

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

MEASUREMENT OF LEVELS OF POTASSIUM BROMATE AND SOME HEAVY METALS IN BREAD SAMPLES PRODUCED IN PORT HARCOURT METROPOLIS, NIGERIA

OBUNWO C. C & KONNE J. L

Department of Chemistry, Rivers State University of Science and Technology, Nkpolu-Oroworukwo, Port Harcourt, Nigeria

ABSTRACT

In order to determine the compliance level of small-scale bakeries in Port Harcourt metropolis with national and international standards, bread samples from ten (10) of these small-scale bakeries were analysed for levels of potassium bromate, lead (Pb) and iron (Fe) in the samples using appropriate spectrophotometric techniques. From the results, the concentrations of potassium bromate ranged between 0.12 ±0.08 mg/kg and 7.28 ±2.14mg/kg, indicating that all the bread samples had bromate levels higher than the permissible limit (0.02mg/kg). The concentration ranges of Pb and Fe in the samples were 0.23 ±0.10 mg/kg - 7.28 ±2.14mg/kg and 0.45 ±0.10 mg/kg - 6.40 ±2.20mg/kg respectively. 40% of the bakeries recorded higher Pb levels (samples 2, 4, 5 and 8) than the permissible limit while 30% of them recorded higher Fe levels than the permissible limit. It is thus deduced that bakeries 2, 4 and 8 are operating at sub - standard levels.

KEYWORDS: Potassium Bromate, Bread, Lead and Iron Concentrations

INTRODUCTION

Consumption of bread pervades all strata of the human society. Its ever increasing popularity may be linked to its high energy content and low level of cholesterol (Gaman and Sherington, 1981) as well as its high acceptability and the convenience associated with its consumption. Bread production involves major components such as water and wheat flour which affect its textural and crumb properties. Other additives include potassium bromate which acts as a maturing agent by improving the dough processing properties and loaf volume (Emeje *et al.*, 2010). Although bromate has been found as a useful additive in some other products (Magomya *et al.*, 2013), however, the addition of bromate in the production of bread has been found to be responsible for such ailments as cancer and kidney failure (Kurakawa *et al.*, 1986). This led to its ban in bread production in 1993 in Nigeria (Obot *et al.*, 2008).

A number of studies related to bromate in the bakery industry have been carried out (Abubakar *et al.*, 2008; Oloyede and Sunmonu, 2009; Ergetie and Hymete, 2012 and Magomya *et al.*, 2013). Abubakar *et al.*, (2008) noted the use of bromate in bread samples in Sokoto metropolis, inspite of its ban in the country. Oloyede and Sunmonu (2009) studied the potassium bromate content of selected bread samples in Ilorin, Central Nigeria and its effects on some enzymes of rat liver and kidney. They concluded that bromate- contained bread samples affected liver and kidney cells as evidenced by reduced activities of AST, ALT and ALP in the studied tissues. Similar studies on the determination of bromate levels in bread samples have also been carried out in other parts of Northern Nigeria (Alli *et al.*, 2013 and Magomya *et al.*, 2013).

Heavy metal introduction in bread production may arise from a number of sources which include (i) their bioaccumulation in wheat and/or flour used in the bakery; (ii) water used in the bakery; (iii) baking fuel types and metal pans used for baking. A number of studies have shown that these factors have contributed to the introduction of metals into

bread samples (Khaniki *et al.*, 2005; Alomary and Wedian, 2012 and Doe *et al.*, 2013). Bioaccumulation of metals in humans has been attributed to be the cause of severe diseases such as tubular growth, kidney damage, cancer and diarrhoea (Magomya *et al.*, 2013).

These earlier studies in some parts of the country necessitated the present research work on the levels of bromate and some metals in bread samples produced in Port Harcourt city. In spite of the fact that the city is one of the most industrialized cities in the country as well as the seat of Government of Rivers State and the hub of oil and gas activities in the country (with its attendant influx of artisans, goods and services), a study to ascertain the quality of bread sold in the city had not been carried out. This study was directed at the small scale bakeries. These bakeries were found to be located in residential buildings and some obscure places which might not catch the attention of the regulatory agencies (e.g. NAFDAC). These bakeries produce loaves that are comparatively less costly and quite affordable to the generality of low income earners in the city.

METHODOLOGY

Following a reconnaissance tour of Port Harcourt city, ten (10) small- scale bakeries were identified. These bakeries baked cheap round loaves of bread that were quite affordable to the low-income earners. A number of loaves of bread were purchased from each of these bakeries. The loaves from each bakery were dried in the oven for about 90 minutes at a temperature of 110^{o}C and ground to a powdered form, on cooling. The mean values of the samples were recorded for each bakery. To 1.0g of the powdered bread sample in a test tube, 10ml of distilled water was added. The mixture was stirred thoroughly and then heated on a water bath. On cooling, the content was filtered and the filtrate transferred into a beaker. 5.0ml of 0.5% potassium iodide in 0.1M hydrochloric acid solution was added to the filtrate to determine qualitatively the presence of potassium bro mate in the sample. A colour change from yellow to pink or purple indicated the presence of bromate.

For quantitative measurement, a calibration curve was developed using aliquots of potassium bro mate solution of varying concentrations and reading off the absorbance on the UV-VIS spectrophotometer. The absorbance of the colour developed in the filtrate of the bread sample was read off on the calibration curve and the concentration of potassium bro mate in the sample determined. Levels of heavy metals in the bread sample were also determined by weighing 1.0g of the ground sample into a digestion tube and digesting it with 10 ml of a mixture of concentrated HNO_3 and concentrated HCl (in 3:1 ratio) on a hot plate. On cooling, the digested sample was filtered into a 50ml volumetric flask and made up to the mark with distilled water. The filtrate was then aspirated into the Atomic Absorption Spectrophotometer (AAS) and the levels of the metals (Pb and Fe) determined.

RESULTS AND DISCUSSIONS

The results of the study show that the mean bro mate levels in the ten samples ranged between 0.12 ±0.08mg/kg and 7.28 ±2.14mg/kg (Table 1). The highest level was recorded in sample 4, located in one of the numerous slums in the city. Lead (Pb) concentrations in the samples ranged between 0.23±0.10mg/kg and 5.15±1.20mg/kg. The concentrations of Iron (Fe) in the samples also ranged between 0.45±0.10mg/kg and 6.40± 2.20mg/kg.

All the bread samples obtained from the ten bakeries recorded, in varying degrees, the presence of potassium bromate. We also observed that the concentrations of bro mate in the samples exceeded the permissible limits of 0.02mg/kg set out by the National Agency for Food and Drug Administration and Control (NAFDAC).

Although the bro mate levels in the class of bread analysed were quite high and thus constituted a danger for the consumption of such loaves of bread, it could be said that the bakers added the bro mate for purely economic reasons. Potassium bro mate is cheap and is probably the most efficient oxidising agent (Akunyili, 2005). The addition of bro mate also gives more bulkiness to the dough development resulting in more loaves of bread being cut out (Abubakar *et al*, 2008). However, the health effects far outweigh the economic benefits. Potassium bro mate is extremely irritating and injurious to tissues especially those of the central nervous system and the kidneys (Oloyede and Sunnmonu, 2009). Unfortunately, the consumers of these cheap loaves of bread are generally children and the low- income earners who are ignorant of the health risks associated with bro mate-laden bread samples. Studies in some other cities in Nigeria (Abubakar *et al*, 2008; Oloyede and Sunnmonu, 2009; Alli *et al.*, 2013 and Magomya *et al.*, 2013) have also recorded the presence of potassium bromate in loaves of bread, despite its ban by the regulatory body, NAFDAC.

The levels of some heavy metals (Pb and Fe) studied in the bread samples were as follows: Mean Pb levels ranged between 0.23± 0.10mg/kg and 5.15± 1.20mg/kg. The mean Fe levels, on the other hand, ranged between 0.45± 0.10mg/kg and 6.40± 2.20mg/kg. Permissible levels of Pb and Fe in food substances are in the ranges of 0.2 – 2.5mg/kg and 2.5 – 5.0mg/kg respectively (Magomya *et al.*, 2013). From the results obtained, samples 2, 4, 5 and 8 had higher levels of Pb than the permissible concentration required. Similarly, samples 2, 4 and 8 recorded higher levels of Fe than the recommended permissible limit in food substances. These results thus indicate that bakeries producing bread samples 2, 4 and 8 are operating at sub - standard levels.

CONCLUSIONS

The results indicate that bread produced by these unregistered small scale bakeries in Port Harcourt contain potassium bromate above the permissible level. A significant proportion of them also introduce higher Pb and Fe levels in the loaves than the permissible levels in food substances by the regulatory agencies. As earlier indicated, bread is considered a staple food in Nigeria. It becomes thus worrisome that toxic chemicals and metals are unwittingly introduced into the menu of majority of the citizens. The health effects arising from the introduction of these chemicals may be far- reaching and devastating, especially to the unsuspecting public. There is, therefore, the need for the regulatory agencies to carry out regular and systematic monitoring of bakeries, particularly the unregistered ones that operate in obscure places.

Table 1: Potassium Bromate and Metal Concentrations in Some Bread Samples in Port Harcourt

Bread Sample	$KBrO_3$ Concentration (mg/kg)	Lead (Pb) Concentration (mg/kg)	Iron (Fe) Concentration (mg/kg)
1	3.16 ± 1.13	2.13 ± 1.77	4.41 ± 2.38
2	5.32 ± 2.72	5.15 ± 1.20	5.52 ± 2.63
3	2.96 ± 0.64	2.34 ± 0.70	1.21 ± 1.40
4	7.28 ± 2.14	3.60 ± 1.14	6.40 ± 2.20
5	6.42 ± 1.57	4.24 ± 1.43	1.22 ± 0.45
6	0.12 ± 0.08	0.23 ± 0.10	0.45 ± 0.10
7	4.71 ± 1.91	1.83 ± 0.37	3.14 ± 1.88
8	5.47 ± 0.38	4.76 ± 2.60	5.11 ± 1.44
9	2.25 ± 0.22	1.82 ± 1.88	3.67 ± 2.76
10	4.66 ± 1.50	1.12 ± 0.24	2.82 ± 0.27

REFERENCES

1. Abubakar, M. G; Abbas, A. Y and Faseesin, B. A (2008): Potassium bromate content of bread produced in sokoto metropolis. Nigerian Journal of Basic and Applied Sciences, 16(2), 183 – 186.
2. Akunyili, N. D (2005): Eradication of potassium bromate from Nigerian bakery industry.
3. Alli, L. A; Nwegbu, M. M; Inyang, B. I; Nwachukwu, K. C; Ogedengbe, J. O; Onaadepo, O; Jamda, M. A; Akintan, G. A; Ibrahim, S. O and Onifade, E. A (2013): Determination of potassium bromate content in selected bread samples in Gwagwalada, Abuja – Nigeria. International Journal of Health and Nutrition, 4 (1), 15 – 20.
4. Alomary, A and Wedian, F (2012): The influence of baking fuel types on the residues of some heavy metals in Jordanian bread. Jordan Journal of Chemistry, 7 (1), 81 – 85.
5. Doe, E. D; Awua, A. K; Gyamfi, O. K and Bentil, N. O (2013): Levels of selected heavy metals in wheat flour on the Ghanaian market: a determination by atomic absorption spectrometry. American Journal of Applied Chemistry, 1(2), 17 – 21.
6. Emeje, M. O; Ofoefule, S. I; Nnaji, A.C; Ofoefule, A. U and Brown, S. A (2010): Assessment of bread safety in Nigeria. Quantitative determination of potassium bromate and lead. African Journal of Food Science. 4(6), 394 – 397.
7. Ergetie, Z and Hymete, A (2012): Determination of potassium bromate in bread samples from five bakeries in Addis Ababa, Ethiopia. International Journal of Pharmacy and Industrial Research, 2(4), 397 – 399.
8. Gaman, P. M and Sherington, K. B (1981): The Science of Food. 2nd Edition. Macmillan Publishers, London, 69pp.
9. Khaniki, G. J; Yunesian, M; Mahvi, A. H and Nazmara, S (2005): Trace metal contaminants in Iranian flat breads. Journal of Agricultural and Social Sciences, 1(4), 301 – 303.
10. Kurokawa, Y; Maekawa, A; Takahashi, M and Hayashi, Y (1990): Toxicity and carcinogenicity of potassium bromate. A new renal carcinogen. Environmental Health Perpectives, 87, 309 – 335.
11. Magomya, A. M; Yebpella, G. G; Udiba, U. U; Amos, H. S and Latayo, M. S (2013): Potassium bromate and heavy metal content of selected bread samples produced in Zaria, Nigeria. International Journal of Science and Technology, 2(2), 232 – 237.NAFDAC, 5, 1 – 6.
12. Obot, I. B; Ekop, A. S and Ikpatt, E. N (2008): Anti-nutritional factors and potassium bromate content in bread and flour samples in Uyo metropolis, Nigeria. E- Journal of Chemistry, 5, 736 – 741.
13. Oloyede, O. B and Sunmonu, T. O (2009): Potassium bromate content of selected bread samples in Ilorin, Central Nigeria and its effects on some enzymes of rat liver and kidney. Food and Chemical Toxicology, 47 (8), 2067 – 2070.